

What is claimed is:

1. A method of forming a silicon-on-insulator semiconductor device comprising:

providing a substrate;

forming a trench in the substrate, wherein the trench includes opposing side walls extending upwardly from a base of the trench;

depositing at least two insulating layers into the trench to form a shallow trench isolation structure, wherein an innermost of the insulating layers substantially conforms to the base and the two side walls of the trench and an outermost of the insulating layers spans the side walls of the trench so that a gap is formed between the insulating layers in the trench.

2. The method according to claim 1, wherein the insulating layers comprise  $\text{SiO}_2$ .

3. The method according to claim 1, wherein the gap between the insulating layers in the trench is filled with air.

4. The method according to claim 1, wherein the gap is substantially sealed.

5. The method according to claim 1, wherein the gap comprises a vacuum.

6. The method according to claim 1, wherein the gap comprises between about 30% and about 50% of the cross-sectional area of the trench.

7. The method according to claim 1, further comprising depositing a first conformal insulating film onto the base and the side walls of the trench prior to depositing the insulating layers.

8. The method according to claim 7, wherein the conformal insulating film comprises  $\text{Si}_3\text{N}_4$ .

9. The method according to claim 1, further comprising planarizing the outermost insulating layer to the substrate.

10. The method according to claim 1, further comprising forming a buried oxide layer on the substrate, forming a process layer on the buried oxide layer, and patterning channels in the process layer and the buried oxide layer to form isolation regions of the substrate prior to etching the trench in the isolation region of the substrate.
11. The method according to claim 10, wherein the process layer comprises  $\text{Si}_3\text{N}_4$ .
12. The method according to claim 10, wherein the process layer has a thickness of about 1000 angstroms.
13. The method according to claim 10, wherein the process layer is formed through a deposition process.
14. The method according to claim 10, wherein the buried oxide layer has a thickness of between about 500 angstroms and about 2500 angstroms.
15. The method according to claim 1, wherein the trench is anisotropically dry-etched.
16. The method according to claim 1, wherein the trench has a depth of about 500 angstroms.
17. The method according to claim 1, wherein innermost of the insulating layers has a thickness of about 100 angstroms.
18. The method according to claim 1, wherein outermost of the insulating layers has a thickness of about 2,000 angstroms.
19. The method according to claim 1, wherein the trench has a width of about 1,200 angstroms.
20. The method according to claim 19, wherein the trench has a trench angle of between about  $70^\circ$  and  $85^\circ$ .